Remarks: General

The claims have been amended by rewriting Claims 2 and 24~27; canceling Claims 18~23 and 40~53 without prejudice to or disclaimer of the subject matter thereof; and adding new Claims 54~82. No new matter is added by these amendments.

Support in the specification for certain claim elements contained in new Claims 54~82 that were not present in the claims as originally filed is as follows:

in Claim 54, support for the recitation as to removal of little or none of the electron field emitter may be found on page 8 at line 37;

in Claims 55~58, 73 and 74, support for the recitation as to multiwall carbon nanotubes may be found on page 26 at line 17;

in Claim 60, which corresponds generally to Claim 1, support for the recitation of no translational motion may be found on page 9 at line 4;

in Claim 61, which corresponds generally to Claim 1, and in Claims 76~78, support for the recitation of liquid material may be found on page 9 at line 9;

in Claim 62, which corresponds generally to Claim 1, in Claim 64, which corresponds generally to Claim 12, and in Claim 65, which corresponds generally to Claim 13, support for the recitation of before firing may be found on page 8 at lines 7~8;

in Claim 66, which corresponds generally to Claim 1, in Claim 67, which corresponds generally to Claim 12, and in Claim 68, which corresponds generally to Claim 13, support for the recitation as to fabrication may be found on page 7 at lines 37~38;

in Claims 77 and 78, support for the recitation as to a step of heating may be found on page 9 at line 12;

in Claim 79, support for the recitation as to a thermally softened polymer film may be found on page 9 at line 21;

in Claim 80, support for the recitation as to the named polymeric materials may be found on page 9 at line 24~37; and

in Claim 81, support for the recitation as to protrusion of particles may be found on page 8 at line 17.

Claim 82 is supported in the present application, and in provisional applications Serial Number 60/213002, filed June 21, 2000 and Serial Number 60/213159, filed June 22, 2000, from which the present application claims priority, as shown in the following table:

	Pending Application	Provisional Appls. No. 60/213002 60/213159
A process	Page 5, lines 11-12	Page 5, line 1
for improving emission current density of a carbon nanotube electron field emitter	Page 14, lines 9-10	Page 10, lines 34-35; Example 1, page 10
said process comprising the steps of: forming a carbon nanotube layer by screen printing a carbon nanotube paste through a patterned screen onto a substrate	Page 7, lines 11-16 Page 6, lines 10-13	Page 7, lines 1-6
wherein a plurality of conductive pattern is formed thereon	Page 6, lines 10-13	Page 10, lines 21-23 Page 6, lines 2-3
so as to form a field emission display device	Page 10, line 12	Page 9, line 11
performing a drying process to said substrate	Page 6, lines 9-10	Page 10, lines 25-26
performing a firing process; and	Page 7, lines 17-19	Page 10, lines 26-27 Page 7, lines 6-8
performing a taping process.	Page 8, lines 10-17 Page 9, lines 12-16	Page 7, line 35-Page 8, line 2 Page 8, lines 30-33

The amendments to Claims 2 and 25~27 are not related to patentability inasmuch as they are made solely for the purpose of correcting typographical errors. The amendment to Claim 24 is not related to patentability inasmuch as it is made solely for the purpose of covering additional subject matter that Applicant believes is needed to properly protect the invention.

In view of the cancellation of Claims 18~23 and 40~53, a request and amendment to correct inventorship under 37 CFR 1.48(b) is enclosed, for which the fee stated in §1.17(i) is due. Please charge this fee to Deposit Account No. 04-1928 (E.I. du Pont de Nemours and Company).

A supplemental Information Disclosure Statement ("IDS") pursuant to 37 CFR §1.98 is enclosed, for which the fee stated in §1.17(p) is due by reason of §1.97(c)(2). Please charge this fee to Deposit Account No. 04-1928.

A petition under 37 CFR §1.136 for a two-month extension of time to respond the Examiner's action is enclosed, the fee for which should be charged to Deposit Account No. 04-1928.

The fees due by reason of the amendment and addition of claims in this response are calculated on the attached sheet and may be charged to Deposit Account No. 04-1928. If the calculation on the attached sheet is in error, please charge or credit Deposit Account No. 04-1928 accordingly.

If any fee other than or in addition to those mentioned specifically above is required to authorize or obtain consideration of this response, please charge such fee to Deposit Account No. 04-1928.

Claims 1~17, 24~39 and 54~82 are now active in the application. Applicant hereby requests reconsideration and further examination of the application in view of the reasons it has set forth below for the allowability of the claims.

Remarks: Detailed Acti n

I.

The Examiner has required affirmation of the election of Group I, Claims 1~17 and 24~39. Applicant affirms the election, and has cancelled Claims 18~23 and 40~53.

II.

The Examiner has stated that the oath or declaration is defective and has required a new oath or declaration.

A copy of the original application data sheet is attached. As the zip code of each inventor was set forth therein, Applicant requests the Examiner to withdraw his finding that the oath or declaration is defective.

III.

The Examiner has objected to Claims 2 and 25~27 because of various informalities.

As each of Claims 2 and 25~27 has been amended to correct the noted informality, Applicant respectfully requests the Examiner to withdraw the objection thereof.

IV.

In Item 10, the Examiner has rejected Claims 1, 2, 13~15, 24, 29~30 and 34 under 35 U.S.C. §102(e) as being anticipated by US 6,097,138 ("Nakamoto").

Nakamoto discloses a field emission cold-cathode device containing a support member and an emitter arranged on the support member to emit electrons wherein the emitter is a fullerene or a carbon nanotube ("CNT").

IV(a).

In one method for making such a device, as described at 9/6~32 of Nakamoto, a CNT layer is formed by depositing carbon on a collecting member. The CNT layer sticking to the collecting member is then pressed against a synthetic resin layer in a molten state. After

the synthetic resin layer is dried to form a support substrate, the collecting member is removed from the CNT layer, and the CNT layer is transferred from the collecting member onto the support substrate. A conductive material layer is then formed on the support substrate, a resist is coated, and the CNT layer and the conductive material layer are patterned in accordance with an emitter layout.

Although Nakamoto does in this embodiment place a synthetic resin layer in contact with CNTs, Nakamoto does so to transfer CNTs from a collecting member to a precursor for a substrate. The collecting member is not intended for use by Nakamoto as an electron field emitter. Nakamoto does not pattern an emitter until after the synthetic resin layer, containing the transferred CNTs, has dried to form a substrate.

The synthetic resin layer in Nakamoto is contacted with CNTs to begin preparation of an emitter by obtaining a sufficient deposit of CNTs onto a substrate precursor. There is no disclosure that CNTs would or should be retained on the collecting member, and no disclosure of what further processing would occur in such event, because no use exists for the collecting member except to participate in the transfer of CNTs to the synthetic resin layer. The synthetic resin layer apparently removes all of the CNTs from the collecting member, and no reason is disclosed or apparent why or how CNTs would or should be retained on the collecting member except as a result of inefficiency of transfer to the substrate precursor.

Nakamoto thus does not teach or suggest (i) a process in which a material forms an adhesive contact with an electron field emitter (as required by Claim 1), (ii) a process in which a force is applied essentially normal to an electron field emitter (as required by Claims 13, 14/13 and 15), or (iii) an article characterized by improved emission as a result of either of those processes (to-wit: the electron field emitter of Claims 24 and 29, and the field emission triode of Claims 30 and 34).

As described above, the synthetic resin layer in Nakamoto does not contact an electron field emitter, it contacts a CNT collecting member. As the CNTs are removed from the collecting member for transfer to the synthetic resin layer as a precursor for the substrate, Nakamoto does not teach or suggest a process in which a portion of an electron field emitter is removed or rearranged thereby forming a new

surface of the electron field emitter (as required by Claim 1), or a process in which a force results in the removal of a portion of an electron field emitter thereby forming a new electron field emitter surface (as required by Claim 13). In contacting the synthetic resin layer with CNTs solely for the purpose of transferring the CNTs off of the collecting member, Nakamoto shows no appreciation for the possibility of applying the synthetic resin layer in a situation where a new surface for an electron field emitter is thereby formed. A new surface for an electron field emitter is not formed by this phase of the Nakamoto proces because all of the CNTs are transferred off of the collecting member to the synthetic resin layer, but neither the collecting member nor the synthetic resin layer is intended for use as an electron field emitter at the time of the contact between them.

IV(b).

At 11/55 ~ 12/8, Nakamoto further discloses a process in which an insulating layer is formed on the surface of an emitter, and a resist layer is then formed on the surface and is patterned such that the insulating layer is exposed at portions where gate electrodes are to be formed. A gate electrode layer is formed on the surface, and the resist layer is then removed by lift off together with unnecessary portions of the gate electrode layer.

This portion of Nakamoto does not teach or suggest (i) a process in which a material forms an adhesive contact with an electron field emitter, (ii) a process in which a force is applied essentially normal to an electron field emitter, or (iii) an article characterized by improved emission as a result of either of those processes. Lift off is typically a wet method in which a solvent is applied to dissolve the resist, taking away any film on top if it as well. The use of lift-off thus does not teach or suggest the processes and articles of Claims 1, 13~15, 24, 29, 30 and 34 because it does not involve making an adhesive contact or applying a force.

IV(c).

At 14/4 ~ 17/11, Nakamoto further discloses a process in which a recess is formed in an insulating layer, CNTs are arranged on the bottom of the recess, and a layer is formed from conductive material so as to bury the recess. When the insulating layer is removed, a tip in the conductive layer is formed with CNTs protruding therefrom. The recess has thus served as a mold for the formation of an emitter.

This portion of Nakamoto does not teach or suggest (i) a process in which a material forms an adhesive contact with an electron field emitter, (ii) a process in which a force is applied essentially normal to an electron field emitter, or (iii) an article characterized by improved emission as a result of either of those processes because it does not involve making an adhesive contact or applying a force to an electron field emitter. One layer is simply used as a mold for the formation of another layer into an emitter. This does not teach or suggest that a portion of an existing electron field emitter be rearranged thereby forming a new surface of the electron field emitter.

In view of the distinctions as discussed above between Nakamoto and the subject matter of Claims 1, 2, 13~15, 24, 29, 30 and 34, Applicant respectfully requests that the Examiner withdraw the rejection of those claims under 35 U.S.C. §102(e). New Claims 54~82 are also patentably distinguishable from Nakamoto for the same reasons as set forth above.

V.

In Item 12, the Examiner has rejected Claims 2~4, 25~27, 31, 32, 35, 36 and 38 as being unpatentable under 35 U.S.C. §103(a) as being unpatentable over Nakamoto.

As set forth above, Nakamoto does not teach or suggest (i) a process in which a material forms an adhesive contact with an electron field emitter, and, upon separation of the material, a portion of an electron field emitter is removed or rearranged thereby forming a new surface of the electron field emitter (as required by Claims 2~4), or (ii) an article characterized by improved emission as a result of that process (such as in Claims 25~27, 31, 32, 35, 36 and 38).

The Examiner has stated that it is well known in the art that a portion the electron field emitter will be removed from the material when the material is separated from the electron field emitter, and this configuration increases the field emission efficiency and reduces the consumption power. The Examiner has also cited to the abstract of Nakamoto and the portion of Nakamoto at column 2, lines 23~25.

Applicant can find nothing in the abstract of Nakamoto or at column 2, lines 23~25, about the separation of material. Applicant therefore respectfully requests the Examiner to provide evidence of his assertion that it is well known in the art that a portion the electron field emitter will be removed from the material when the material is separated from the electron field emitter, and this configuration increases the field emission efficiency and reduces the consumption power.

In view of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 2~4, 25~27, 31, 32, 35, 36 and 38 under 35 U.S.C. §103(a). New Claims 54~82 are also patentably distinguishable from Nakamoto for the same reasons as set forth above.

VI.

In Item 13, the Examiner has rejected Claims 5, 6, 16, 17, 33, 37 and 39 under 35 U.S.C. §103(a) as being unpatentable over Nakamoto in view of U.S. Patent No. 6,277,318 ("Bower").

Bower discloses a method for fabricating adherent patterned CNT films. A substrate is patterned with a carbide-forming material, a carbon-dissolving material or a low melting point metal. CNTs are then deposited onto the patterned substrate, and the substrate is annealed at a temperature at which carbide formation or carbon dissolution occurs, or the metal melts, thus providing an adherent CNT film over the patterned area. The use of single wall CNTs is disclosed at column 3, line 46. The adhesion strength of the resultant patterned nanotube films is sufficient to exceed the 2A or 2B scale in the ASTM test D 3359-97.

In Test Method A of ASTM D 3359-97, the film to be tested is on a metal substrate, and an X-shaped cut is made in the film through to the substrate such that light reflected from the metal substrate may be observed. Tape is placed on the cut with the center of the tape at the intersection of the legs of the X, and the tape is rubbed firmly with the eraser on the end of a pencil. The tape is then removed, and the area of the cut is inspected for the removal of film material. Results that exceed 2A on the rating scale are characterized by some degree of film removal along the incision, or no peeling or removal.

In Test Method B of ASTM D 3359-97, the film to be tested is on a metal substrate. Perpendicular cross-hatch cuts are made in the film, with the cuts being made through to the substrate such that light reflected from the metal substrate may be observed. Tape is placed over the grid, and the tape is rubbed firmly with the eraser on the end of a pencil. The tape is then removed, and the grid area is inspected for the removal of film material. Results that exceed 2B on the rating scale are characterized by removal of flakes of the coating to some degree, or smooth edges on the cuts with no squares of the lattice detached.

A copy of ASTM D 3359-02 is enclosed. On page 397, a summary of the changes to D 3359-97 that occurred in the preparation of D 3359-02 is set forth. The content of those changes involves aspects of the test that are not relevant to the discussion herein.

No claims are rendered unpatentable by Nakamoto when read in view of Bower because, as set forth above, Nakamoto itself does not teach or suggest (i) a process in which a material forms an adhesive contact with an electron field emitter, (ii) a process in which a force is applied essentially normal to an electron field emitter, or (iii) an article characterized by improved emission as a result of either of those processes.

Bower's disclosure of single wall CNTs adds nothing to overcome the deficiencies of Nakamoto because there is no motivation for the artisan to combine the teachings of those two references. Nakamoto prepares a substrate for eventual patterning to form an emitter by transferring CNTs to a synthetic resin layer that is allowed to dry. In Bower, by contrast, a substrate is prepared by depositing carbon-dissolving or -forming materials or low melting metals in a desired pattern. CNTs are then deposited on the patterned substrate, the substrate is annealed to induce carbon dissolution, carbide formation or melting of the metal to obtain well-adhered CNTs in the area of the pattern. CNTs that were deposited in areas outside of the pattern are not well adhered and may be easily removed.

Each of these is a complete process in itself, and no opportunity exists for adding to one a step taken from the other without creating an unworkable process. In Nakamoto, it would not

be possible to pattern the synthetic resin layer before depositing CNTs because the synthetic resin layer would then be dried and would not have the necessary tackiness to hold transferred CNTs; or if the resin layer were softened or remelted, the patterning would be lost. In Bower, it would not be possible to deposit CNTs on a patterned substrate that had been melted because CNTs would adhere to entire area, and it would not then be possible to later remove CNTs that had been deposited in areas outside of the pattern.

In Bower, after the substrate has been annealed, and CNTs outside of the pattern have been removed, the adherence of the CNTs within the pattern is evaluated according to ASTM D 3359-97. The ASTM test involves the application of a tape to a surface of a film that has been scored. No purpose would be served by instead applying to the surface a molten synthetic resin layer because the synthetic resin layer, after drying, would peel away most, if not all, of the surface of the film, particularly from under the surface at the location of the incisions, and results would be obtained that would unintelligible in terms of the scales set forth in ASTM D 3359-97. The fact that Bower performs the test in ASTM D 3359-97 on CNTs provides no motivation for the artisan to combine Nakamoto with Bower.

Claims 5, 6, 16, 17, 33, 37 and 39 are patentably distinguishable from Bower because the ASTM test requires making incisions in the film through to the substrate. If a step of cutting an electron field emitter through to a substrate is performed, improved field emission (as recited by Claims 5, 6, 16, 17, 33, 37 and 39) will not be attained because the uniformity of emission of the electron field emitter will be degraded. Uniformity of emission will be degraded because the areas of the electron field emitter where the cuts through to a substrate have been made will emit with a different intensity than the areas where no cuts have been made. New Claims 54~82 are patentably distinguishable from Bower for the same reason.

In view of the distinctions between the pending claims and the disclosures of Nakamoto, Bower and a combination thereof, Applicant respectfully requests the Examiner to withdraw the 35 U.S.C. §103(a) rejection of any claim over Nakamoto, Bower or a combination thereof.

VII.

In Item 14, the Examiner has rejected Claim 12 under 35 U.S.C. §103(a) as being unpatentable over Nakamoto in view of U.S. Patent No. 6,057,637 ("Zettl").

Zettl discloses an electron beam field emission source prepared from a nanotube matrix in which the field emitter material is a binder and nanotubes suspended in the binder. The field emitter material can also be nanotube-rich material bound into a matrix without using a binder. In the latter case, nanotube-rich material is compacted in a simple pellet press (piston/cylinder device) to a pressure sufficient to have the nanotubes "stick" to each other and form a cohesive matrix.

As set forth above, Nakamoto does not teach or suggest a process in which a force is applied to the surface of an electron field emitter thereby forming a new surface of the electron field emitter.

Zettl adds nothing to overcome the deficiencies of Nakamoto as a reference because Zettl is concerned with making a matrix of either nanotubes and a binder or nanotube-rich material itself. For example, at 5/56~60 nanotube-rich material is compacted in a piston/cylinder device to a pressure sufficient to have the nanotubes stick to each other and form a matrix. Although in the process of forming such a matrix, individual nanotubes may be fractured, this has no relation to applying a force to an electron field emitter. It is only after the matrix is formed by such compression in Zettl that it is attached to a substrate for eventual use as an emitter.

Further, at 6/20~31, Zettl describes making a pixel by placing a binder/nanotube mixture between glass slides for curing. A crosswise strip is cut from the slide-matrix assembly, and the short end of the strip is then ground back to expose a square sample facet, which serves as the electron emission surface. While the action of cutting may apply a force to the slide-matrix assembly, that force does not form a new surface of an electron field emitter as required by Claim 12. The new surface of the pixel in Zettl is formed instead by grinding.

In view of the distinctions discussed above between Claim 12 and the disclosures of Nakamoto and Zettl, Applicant respectfully

requests the Examiner to withdraw the rejection of Claim 12 under 35 U.S.C. §103(a).

VIII.

In Item 15, the Examiner has rejected Claims 8~11 under 35 U.S.C. §103(a) as being unpatentable over Nakamoto in view of Bower and U.S. Patent No. 6,146,230 ("Kim").

Kim discloses a composition for an electron field emitter of a field emission display containing electron emitting materials, a dispersion agent including polyoxyethylene nonyl phenyl ether derivative or polyvinylpyrrolidone, a binder including silane based compounds or colloidal silicas, and pure water. The amount of electron emitting material is preferably 1~50 wt%, more preferably 5~30 wt%, and most preferably 10~20 wt% of the total composition.

As set forth above, Nakamoto does not teach or suggest a process in which a material forms an adhesive contact with an electron field emitter, and Bower does not teach or suggest a process in which the field emission of an electron field emitter is improved by the rearrangement of a portion of the electron field emitter.

Kim adds nothing to overcome the deficiencies of Nakamoto and Bower because it discloses nothing but amounts of emitting material in an electron field emitter composition, and does not teach or suggest the specific process steps that distinguish Claims 8~11 over the other references.

In view of the distinctions discussed above between Claims 8~11 and the disclosures of Nakamoto, Bower and Kim, Applicant respectfully requests the Examiner to withdraw the rejection of those claims under 35 U.S.C. §103(a).

IX.

In Item 16, the Examiner has objected to Claims 7 and 28 as being dependent on a rejected base claim, and has stated that those claims would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. In Item 17, the Examiner has presented a statement of reasons for allowance of Claims 7 and 28.

While Applicant agrees that Claims 7 and 28 are allowable, Applicant has not amended those claims because Applicant submits that those claims are allowable in their form as originally written for the additional reason that the base and intervening claims are allowable themselves, as discussed above.

X.

Applicant has reviewed the references that have been made of record but have not been relied on, and submits that U.S. Patent No. 6,250,984 ("Jin") is of no greater pertinence to the pending claims than the references discussed in detail above. U.S. 6,436,221 ("Chang") is discussed below.

XI.

New Claim 82 is modeled on Claim 1 of US 6,436,221, filed February 7, 2001, issued August 20, 2002, and assigned to Industrial Technology Research Institute. An interference with US 6,436,221 is requested. A proposed count is as follows:

1. A method of improving current density for a carbon nanotube (CNT) emitter source, said method comprising the steps of:

forming a CNT layer by screen-printing a CNT paste through a patterned mesh onto substrate, wherein a plurality of conductive pattern is formed thereon so as to form emitter pixel array;

performing a soft bake process to said substrate;

performing a sintering process; and

performing a taping process.

or

82. A process for improving emission current density of a carbon nanotube electron field emitter, said process comprising the steps of:

forming a carbon nanotube layer by screen-printing a carbon nanotube paste through a patterned screen onto a substrate, wherein a plurality of conductive pattern is formed thereon so as to form a field emission display device;

performing a drying process to said substrate;

performing a firing process; and

performing a taping process.

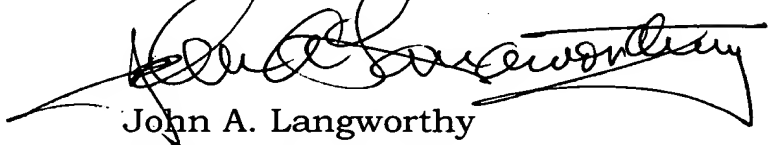
At least Claim 1 of US 6,436,221 corresponds to Count 1. At least Claim 82 of the present application corresponds to Count 1. Applicant submits that there is an interference in fact between Claim 82 of this application and Claim 1 of US 6,436,221 because Claim 82, if earlier, would render Claim 1 unpatentable, and Claim 1, if earlier, would render Claim 82 unpatentable.

Applicant has shown on page 5 proper support for Claim 82 in its earliest application, U.S. Provisional Application No. 60/213002, filed June 21, 2000, and therefore requests that it be accorded in the interference the benefit of the filing date of that application, which would make Applicant the senior party in the interference.

As Claim 1 was found allowable in US 6,436,221, and as Applicant's June 21, 2000 date is earlier than the filing date of the application from which US 6,436,221 issued (no claim to priority being shown therein), Claim 82 should be allowable for the same reasons as Claim 1.

In view of the foregoing, Applicant submits that all of the Examiner's objections and rejections have been properly traversed, and that the pending claims are in condition for allowance. Applicant respectfully requests that a notice of allowability of all pending claims be issued, and that the case be forwarded to the Board of Patent Appeals and Interferences with a favorable recommendation for the declaration of an interference with US 6,436,221

Respectfully submitted,



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